WCDMA Networks – The Beauty (and Other) Spots

a report by
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Wideband Code Division Multiple Access (WCDMA) networks have been around, in trial/pilot/commercial forms, for almost two years now. There are networks in Europe and Asia that can be tested and measured and at least one commercial network for subscribers to experience. What realistically can these deliver, and what work still needs to be done?

The selling points of WCDMA technology are supposed to be high bandwidth/transmission speed, which, in turn, enables multimedia services like live video calls, plus improvements on 2 and 2.5G GSM/GPRS networks like better speech quality, more capacity, no frequency planning as such, etc.

Measured against these expectations, the WCDMA networks today are delivering the goods, but with some serious restrictions.

The Swiss company Ascom has been measuring live WCDMA networks in Europe and Asia since early 2002, using all the available subscriber terminals like Motorola/Siemens, Nokia, NEC, Samsung, etc. The infrastructures involved include Nortel, Siemens, Nokia, Ericsson, Alcatel and others. Based on this collection of measurement data, it is possible to make some observations in the general performance of these networks.

We all know that, in this initial deployment phase, one cannot expect universal coverage, flawless implementation in the field, brand new subscriber services, abundance of user terminals, sophisticated network management facilities, interoperability with no restrictions and so on. No-one can reasonably expect these attractive things from day one – and they will surely come with time. So what can one realistically get from WCDMA networks today?

Restricting ourselves to areas where there is reasonable WCDMA coverage, making measurements on basic services like speech call, transferring a file, testing reaction/round trip times, etc., and always using the latest firmware to combat interoperability problems, one can see where the strengths (and problems) are.

The interoperability issues one sees tend to be very fundamental – i.e. it either works or it does not. In cases where it does not work, one cannot even register in the WCDMA network, never mind setting up a connection. If the terminal can register, then the connections tend to work as well.

Once we get past registration, there are some general characteristics that appear in almost all the networks tested.

In terms of bandwidth, the peak downlink throughput can be very high (compared with GPRS). It is not uncommon to see peaks of up to 370Kb/s at the application level (e.g. FTP) in a good coverage area. The important word here is 'peak', as we can see later.

For uplink, the throughput can best be described as stable, rather than high. All the networks show uplink throughput of around 45 to almost 60Kb/s (FTP). While this is still better than most GPRS networks, it causes a serious problem for new multimedia services.

The reaction time (PING/round trip delay) between the air interface and the Gi interface can be very low – say 150mS. This is a factor of four or five shorter than most GPRS networks.

The speech quality, once the speech call has been set up, tends to be very good. Most of the measured speech samples have been rated "excellent" (on a scale of "excellent" to "bad").

Besides speech quality, the speech call drop call rate is one of the top key performance indicators for GSM networks, and it is interesting to see how it measures up in WCDMA. Here, the situation is not very clear cut. In pure number terms, the 'typical' speech drop call rate is around 15%. For any mature (i.e. well-tuned) cellular network, this number could represent disaster because one would normally expect, in a good GSM network, to have a drop rate of, say, 2% or less.

However, one should not focus too much on this high number (15%) because of the situation the WCDMA networks are in. Most of the networks measured have some limited coverage and, when the

subscriber approaches the edge of the network, things get interesting. In theory, the speech call in WCDMA should be handed over to a GSM network. This means that the subscriber terminal should be measuring the GSM environment and, on detecting an approaching problem (the call is about to drop), a WCDMA to GSM handover should occur. However, the terminal can measure the GSM network in the area only if it knows what to measure i.e. if the WCDMA network supplies GSM network information to the terminal for it to measure.

In almost all cases tested so far, the WCDMA network was not configured with a GSM network environment. Hence, the subscriber terminal was not in a position to try and find a GSM cell to hand over to – and the call was dropped. This 'edge of WCDMA' drop rate accounted for a major part of the 15% mentioned previously.

In time, one can expect that the WCDMA cells are configured correctly and can send GSM neighbour cells to a terminal working in WCDMA. With that will come the moment of truth, when the co-operation and performance of the terminal, the GSM and the WCDMA networks will be tested to the full. We must also remember that handover from WCDMA to GSM is not just a matter of the air interface. The subscriber profile (who they are and what they are allowed to do/not allowed to do), billing issues, etc., also have to be resolved between the two networks. It will be easier, of course, if both the WCDMA and GSM networks belong to the same operator. If not, then some operations like national roaming would have to be performed.

If we put aside the drop calls due to the missing WCDMA/GSM handover, then the measurement results show that, in good coverage areas, the WCDMA speech call drop rate is approaching the GSM values, i.e. a few per cent.

While peak downlink throughput, reaction time and even drop call rates are the beauty spots in WCDMA, current networks suffer from a few problems as well.

The downlink throughput rate (with high peaks) and the reaction/round trip time can vary widely during a connection. The range can be tenfold, for example the lowest downlink throughput can be just one-tenth of the peak. While this may not be a problem for someone reading e-mail as a background job, it may cause problems in a live video call when high bandwidth should be provided all the time. However, for video calls, this drawback of uneven downlink throughput pales into insignificance when compared with the uplink throughput. All WCDMA measured so far has a maximum of 64Kb/s in uplink, making a live video call almost difficult to watch. This is even more so if the subject matter moves. For even a slow moving object, say a bus in a city centre, there is just not enough bandwidth to convey movements, and the result is a blur. The same would result if we tried to carry the video over GPRS. With a 4+ 1 terminal, the uplink is still limited by the "1" time slot. If WCDMA is to live up to the expectation of good live video calls, then this uplink limit must be improved as soon as possible.

The other improvement needed with today's WCDMA is the quality of service (QoS) implementation, or the lack thereof. In theory, WCDMA has much more elegant QoS specifications and mechanisms, enabling the four traffic classes: conversation, streaming, interactive and background. The subscribers should be able to ask for different characteristics (throughput, delay, etc.) from the network and, with a process of negotiation, agrees with the network what they will get in the connection. However, up to now, no network seems to have implemented this mechanism. This means that one major advantage of WCDMA is still missing.

While we have seen from this is that there are strengths and some (current) weaknesses in WCDMA, we must also remember that all the measurements so far were done in no-load or lightly loaded networks. While today's 'structural' drawbacks of limited uplink bandwidth, no QoS implementation, etc., are not load-dependent, one cannot help wondering what will happen to the beauty spots listed here when the network load increases. We need to look no further than the current coverage for high bit-rate service (say 128Kb/s). This coverage is diminished by pollution and interference. With today's lightly loaded networks, this coverage is already quite restricted.

The current view of some WCDMA network operators is that WCDMA should be introduced without the subscribers noticing. They should be able to use their favourite services, without knowing whether they were delivered via WCDMA or not. While that is certainly good for the subscribers, work still needs to be done in WCDMA networks to bring it to the same maturity as GSM or even GPRS. Only then would this 'technology-independent' method of service delivery become a reality. ■

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